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A COMPARATIVE STUDY OF ONLINE AND OFFLINE METHODS TEACHING CHEMISTRY IN A MEDICAL SCHOOL

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Abstract. Higher medical education has never been distant or implemented online. The years of pandemic have changed the situation. Online lessons become more common even in medical schools. Our purpose was to find out the advantages and disadvantages of online and offline studying methods from students' points of view. We had a unique opportunity to compare online and offline education through the eyes of students who studied in their first year online for the first half of the semester, and offline for the second half of the semester. These students could compare the pros and cons of these learning formats when studying chemistry. The survey was designed to collect information to compare the online teaching and offline teaching of chemistry for medical students. Since different teaching and learning methods were compared by the same people, the contribution of subjectivity in the comparison was reduced. The results of questionnaire answers of students from Kazakhstan were analyzed and compared with other studies' results made all around the world. In this research, the authors believe that feedback from students can help develop and use more accessible and modern ways of teaching as well as ways to improve the quality of education for medical students.

Key words: learning, blended learning, higher education, medical education, teaching chemistry, mixed learning, online learning, offline learning, educational technologies

Introduction

Classical medical education has traditionally been face-to-face education, medical faculties have never even had distance learning. However, with the development of modern technologies new high-tech methods of education have become increasingly popular worldwide. They began to penetrate medical education as well. The trigger for this process was the pandemic when all educational institutions were forced to either stop their activities or transfer the learning process to an online format.

The traditional model of teacher-led lectures and classroom learning has been a mainstay for most higher education institutions for many years. Currently, the possibilities of technology are ahead of the existing education system, blended and distance learning will likely develop shortly [1]. According to [2], online education has a systemic impact on society, and taking this into account, it is necessary to develop advanced, flexible, modern educational technologies, effectively build and maintain a blended and distance learning format, including in the academic practice of medical universities, which in the future may contribute to increasing the availability of digital medical education.

The medical education environment has been forced to change rapidly with the COVID-19 pandemic. This worldwide pandemic has not only created a need but perhaps also provided an opportunity to accelerate the digital transformation of medical

education. Further introduction of online learning methods in medical schools is possibly expected. However, it is important to minimize their shortcomings and maximize the development of online methods [3].

Universities are now undergoing many changes, and the paradigm of education is changing. However, regardless of whether learning is implemented online, blended, or face-to-face, educational institutions need to maintain a high level of education quality.

Online learning is gaining popularity as a leading educational learning, especially during the outbreak of the COVID-19 pandemic. As a result, nowadays different institutions in different countries provide students with education through online pedagogy. The study [4] analyzes student performance on online and offline learning platforms. The authors propose to combine online learning with the traditional learning trend and thus use the privileges of digital learning for effective learning. They concluded that blended learning is the most effective.

Many works are devoted to studying the effectiveness of online and offline learning in medical education. The authors of [5] based on a meta-analysis of data to compare the knowledge and skills of undergraduate medical students obtained using online and offline learning. The authors concluded that the use of online teaching methods in medical education was no less effective than offline learning. They acknowledge that online learning has its benefits for improving student learning and should be considered as a potential teaching method in medical education.

The authors of [6] believe the online mode of learning has become the new norm even for medical specialties. It is important that the medical institution considers the perceptions and preferences of its students regarding the various regimens and works comprehensively to improve their students' satisfaction with the online regimen. The online mode needs to be upgraded with the integration of technology tools to enrich students with practical and clinical knowledge. However, the results of the survey showed that e-learning can help the learning process in medical schools in some aspects but cannot be used for the entire educational process.

The paper [7] emphasizes that online learning has proven itself in medical education and is well-received by students. The e-learning strategy aims to improve the quality of medical education by providing students with equal access to quality learning resources. Online learning can be especially beneficial for postgraduate medical education.

The paper [8] describes the application of a mixed model for teaching anatomy to medical students. The described hybrid learning model combines traditional classes with online lectures. It is widely used to unite the benefits of face-to-face and online courses.

The authors of [3] believe that although an online course is not the same as an offline course, it is possible to increase the effectiveness of online learning to a level that satisfies medical students. Through the online platform, basic surgical skills can also be effectively taught. Even without a pandemic, the online part of the curriculum can be a useful addition to surgical education.

Materials and metods

We had a unique opportunity to compare online and offline learning through the eyes of students who studied in their first year at the Kazakh State Medical University named after S.D. Asfendiyarov. They studied chemistry online for the first half of the semester, and offline - for the second half of the semester. These students were able to compare the pros and cons of these learning formats of studying chemistry.

During online training, students were offered both pre-recorded lectures and online classes using the ZOOM platform with the ability to conduct live conversations/discussions with the teacher (live chat and/or communication with the teacher and group members). Offline lessons were provided in the traditional way of practical lessons and seminars with a teacher.

We have designed the questionnaire to collect students' opinions concerning the pros and cons of these ways of study. The students were asked what they liked/did not like about online and offline learning, what difficulties they have in both ways of study and what choice would they make if they could. The survey questions are given in the table 1.

Table 1 - The survey questions

1. What do you think is the positive side of distant (online) learning? 1) the opportunity to regulate the individual pace of knowledge acquisition 2) comfortable learning conditions 3) the opportunity to communicate with the teacher online 4) availability of information regardless of time 5) increasing independence in mastering the material 6) the opportunity to re-watch the video of the lecture 7) simplification of the control system 8) the absence of stressful situations 9) something different
2. Choose the main disadvantages of distant (online) learning 1) insufficient control of the acquired knowledge 2) lack of self-discipline 3) low level of the Internet at your place of residence 4) insufficient technical equipment for the teacher's work 5) something else (you can write your answer below)
3. What do you think is the positive side of face-to-face learning? 1) the opportunity to communicate with group mates 2) the presence of control by the teacher during classes 3) the opportunity for personal communication with the teacher 4) more strict control in the performance of final tasks 5) something else (you can write your answer below)
4. Choose the main disadvantages of face-to-face learning. 1) a lot of time is spent on transport 2) the presence of hard deadlines 3) not very comfortable conditions 4) something else (you can write your answer below)
5. Is it convenient for you to study remotely? 1) Yes, convenient (I like it) 2) Yes, but it is difficult 3) No, it's very difficult 4) No, it's too easy 5) Difficult to answer

6. The level of motivation for learning you have within the distance form… 1) Increased 2) Does not change 3) Decreased 4) Difficult to answer
7. In your opinion, the teaching load on students during distance learning ... 1) Generally increased 2) Decreased overall 3) Hasn't changed 4) Difficult to answer
8. What difficulties did you encounter in the process of distant learning? 1) Insufficient knowledge of computer technology 2) Not enough material to study online 3) Difficulty in completing practical tasks without teacher explanations 4) The inconvenience of using the distance learning site 5) Large volume of given materials 6) Untimely presentation of materials and assignments by teachers 7) Other...
9. What technical problems did you encounter in the process of distance learning? 1) The need to have access to the Internet 2) My insufficient PC knowledge 3) Some lectures were not displayed 4) It was not clear what I needed to do or where to click 5) Inability to download a lecture or presentation to your PC 6) Technical interruptions in the process of playing the material 7) Poor feedback 8) Low speed of internet connection 9) There were no problems 10) Other...
10. If you had a choice, would you choose... 1) Completely offline learning 2) Completely distance learning 3) Blended learning format, depending on the topic

The results of our survey are analyzed and compared with the data of other researchers.

Results and discussions

In many works, issues related to the advantages and disadvantages of distance learning, as well as the difficulties faced by students, are considered in detail. Of the positive aspects of distance learning, respondents most often note the following: an individual pace of learning, the ability to download lecture materials, the ability to re-watch videos, and the use of modern technologies. The obvious advantages of online learning are also accessibility (territorial, financial, gender, and age), flexible schedule, comfort (choosing a convenient place to study the material, combining it with other things), and saving time. The authors of [7] consider the main advantages of online learning to be its flexibility and the possibility of learning at an independent pace.

According to our research (Figure 1), almost all respondents to this question noted the possibility of re-watching the proposed video lectures as the main advantage of distance learning, it was reported by 70% of students. We believe that re-watching the videos and stopping at the most difficult pieces, help first-year students learn the material better. Many students appreciated the availability of information at any time

(54%) and comfortable learning conditions (50%). For many, the increasing independence in studying the material (42%) and the absence of stressful situations (35%) turned out to be important. Studying at home, students avoid stressful situations that often occur in life, for example, when living in a hostel.

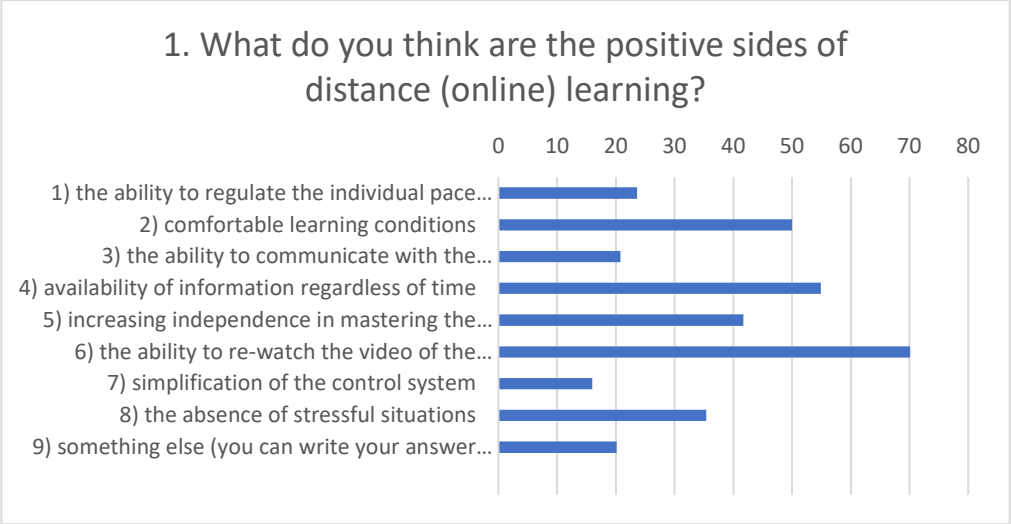

Figure 1 - Advantages of online learning

Many students who found themselves in forced online (distance) learning because of the COVID-19 pandemic in 2020 cite the deterioration of interpersonal communication skills and a decrease in live communication with the teacher as one of the most serious negative consequences of the digitalization of education.

The study [8] showed that many students (66.23%) had difficulty managing their time and they were distracted while studying at home. Most of them (92.92%) admitted that they miss the real social life on campus. The results of the survey [10] indicate that regarding the disadvantages of e-learning, the majority (81.7%) of the respondents found it difficult due to internet problems followed by technical issues (65.5%), reduced interaction with the patients (55.1%), lack of self-discipline 23.8%, reduced socialization (21.9%).

Other works show that 58% note a lack of communication between facilitator and student and 56% - a lack of feedback [9]; a lack of face-to-face interaction was noted by 41% of students and 62.7% of teachers [10]; 42.9% of students missed face-to-face interactions [11].

Our students consider the main disadvantage of online learning (Figure 2) to be the lack of control over the knowledge they receive (49%) and the insufficient quality of the Internet connection in their places of residence (47%). They just graduated from high school, where they were under the scrutiny of the teacher every minute, and therefore the lack of tight control makes them confused and insecure. Many students suffer from a lack of self-discipline (34%) for the same reason, which is 10% higher than in [12].

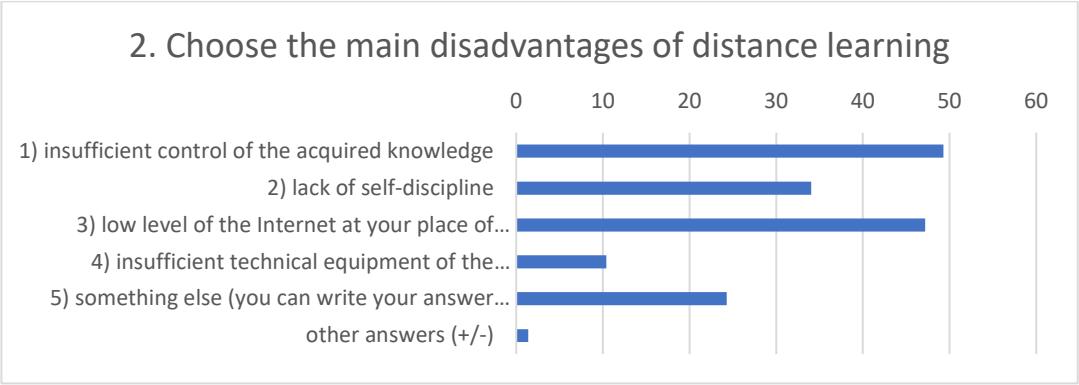

Figure 2 - Disadvantages of online learning

Face-to-face meetings allow the teacher to provide dialogue which is one of the main mechanisms of pedagogical interaction, to support a process of communication, and exchange of views between interlocutors. The teacher, seeing the reaction and degree of involvement of students, can instantly change the trajectory of interaction with the audience to achieve the goals. At the same time, students also could express their emotional opinions immediately, which can be difficult online. Therefore, a face-to-face format of communication between a teacher and a student seems to be the more convenient way to ensure an individual approach, internal enrichment, and activation of potential, and, consequently, a quality transfer of knowledge.

For our students, the opportunity to communicate with group members seems to be very important for most respondents (83%), which is also confirmed by the authors of the article [13] - social interaction of the learners affects students' motivation and study results positively. More than half of students (54%) lack communication with a teacher as well. This result is in line with the results of works [9-11], although our students are more sociable. The openness and sociability of people are typical for our country, which is why students suffer so much from a lack of communication in online learning. 65% of students consider it important to have stricter control by the teacher during classes and current control (52%) (the reason is commented on in the previous question). This is also confirmed by students' answers to question 2, where insufficient control is chosen by many students as one of the main disadvantages of online learning.

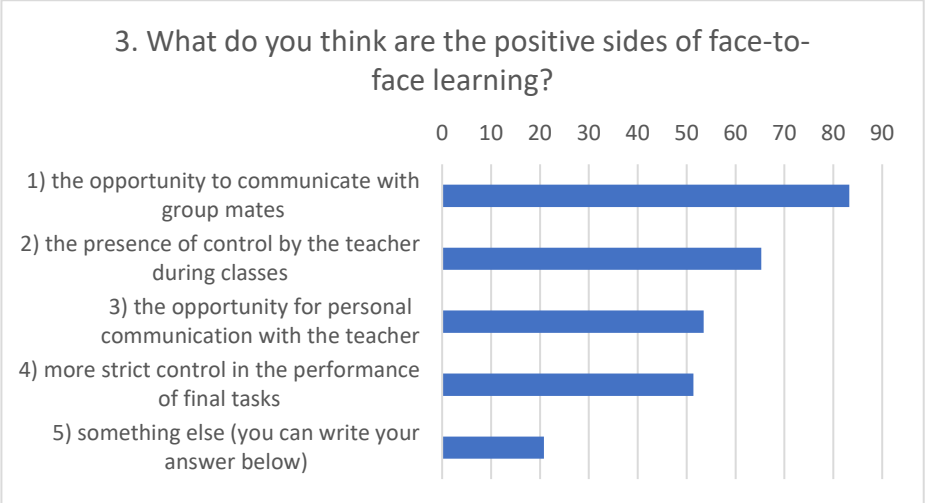

Figure 3 - Advantages of offline learning

The main disadvantages of offline learning are related to economic issues - the need to spend for transport, accommodation, food, and additional time spent on moving from the place of residence to the learning site and back. Possible stressful situations are named as drawbacks of face-to-face learning as well.

In the study [12], for most respondents (72.1%), the advantage of e-learning is the ability to stay at home, which means lower living and transport costs (51.3%), as well as the ability to have meetings recorded (38.1%).

Our survey shows that students consider the main disadvantage of offline learning to be that they must spend a lot of time traveling (68%) because most of them live far from university buildings and have to spend 2-3 hours a day on the way to the lessons or back home. Not very comfortable learning conditions and the presence of strict deadlines were noted by 21% and 20% of the respondents, respectively. 27% of students noted other reasons, such as difficult relationships in the group, the lack of a familiar environment, and the habit of loneliness (figure 4).

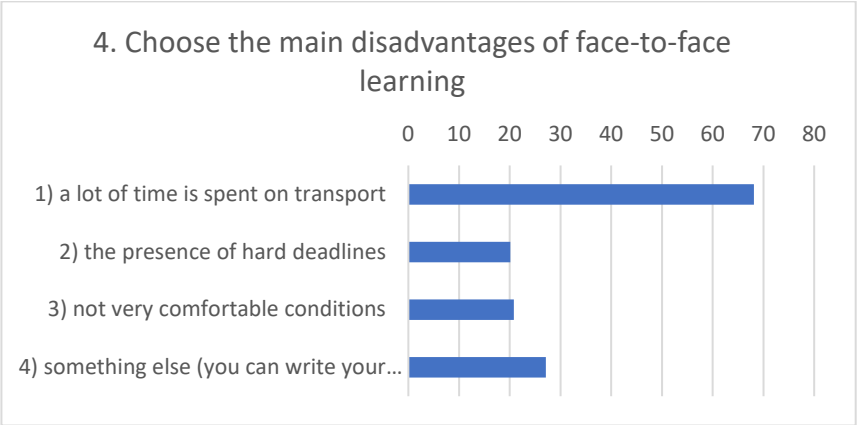

Figure 4 - Disadvantages of offline learning

According to our survey, for most students, online learning is convenient and enjoyable (38%) or is convenient, albeit difficult (28%). For 17% of students, distance learning is inconvenient, as it is very difficult for them. 7% of students found it difficult to answer this question (figure 5).

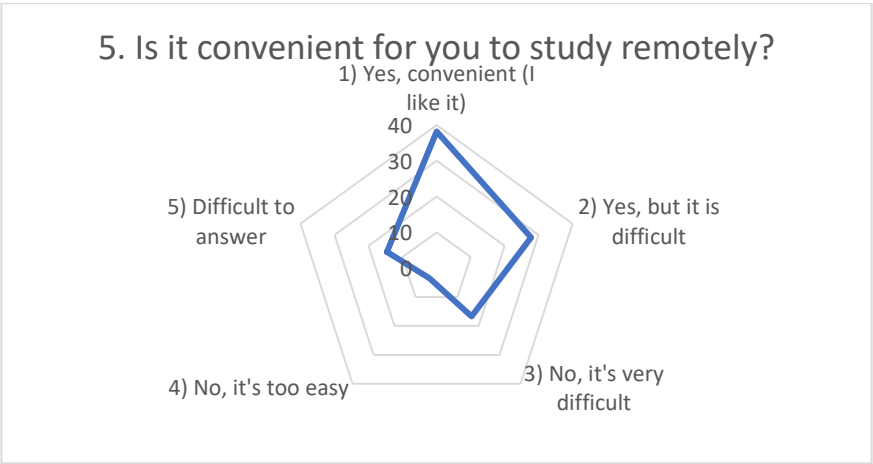

Figure 5 - Convenience of online learning

The problem of self-motivation is considered in [9]. According to the authors' study, when studying basic subjects, 23% of respondents noted a decrease in the level of motivation for distance learning, and for 17% of respondents, the level of motivation did not change. However, 60% noted an increased level of motivation.

In [8], 63.01% of students indicated a lack of self-motivation. The authors [2] believe that the observed decrease in students' motivation to learn in the context of online learning is offset by an increase in hours and opportunities to consolidate knowledge, skills, and abilities.

According to our study, students are quite well motivated to study even in the context of distance learning - for more than 45% of students, motivation does not change when switching to online learning, although, for 26% of students it falls, but for 21% of the respondents, motivation for learning increases. 7% of students found it difficult to answer this question (Figure 6).

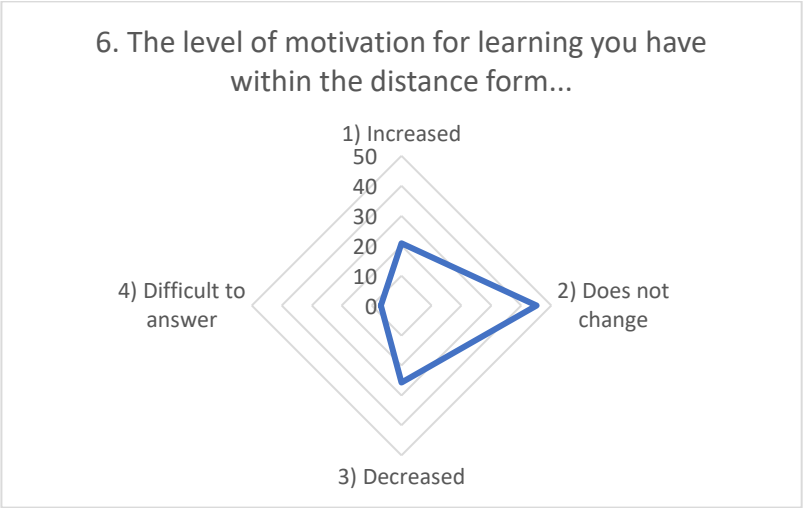

Figure 6 - The change in the level of motivation to study

The studies conducted in [14] show that student performance in online learning is associated with rising effort and mental needs. Some of the frustration with online learning is due to the increased amount of time and effort it takes to compare to offline learning.

The results of our survey show that 37% are sure that student workload does not depend on the form of study, while 31% of students believe that it increases during online learning, and 21.5% of respondents feel that it decreases. 10% of students could not answer this question (figure 7).

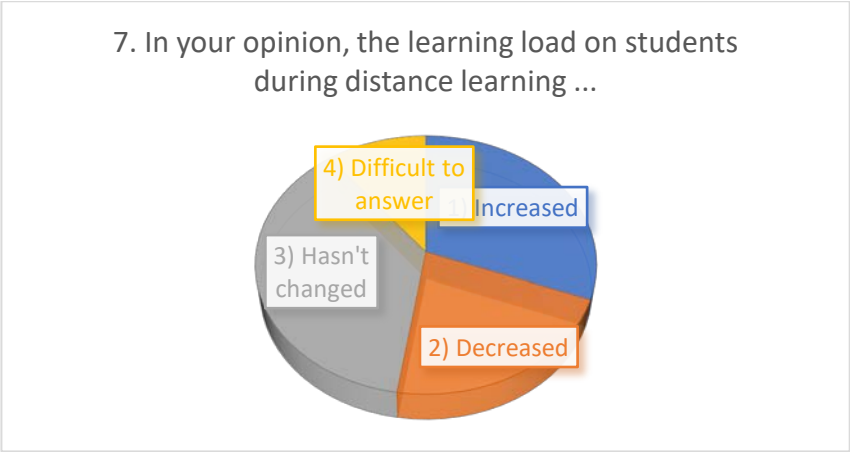

Figure 7 - The change in learning load

In the process of online learning, students encountered some difficulties. The most frequently mentioned problem was the difficulty in completing practical tasks and solving problems without a prior explanation from the teacher. Since we are dealing with students in the first year of study, we believe this is the result of an emotional attachment to the teacher and the lack of the habit of independent work. 31% of students consider the sites and programs offered to them inconvenient for learning, perhaps they do not have sufficient experience with the software. 28.5% of students believe that the material offered to them for preparation is too large, while 17% believe that this is not enough. This is again the problem of first-year students who are not yet accustomed to the style of teaching at the university. 18% of respondents were insecure computer users, which complicated the learning process for them (figure 8).

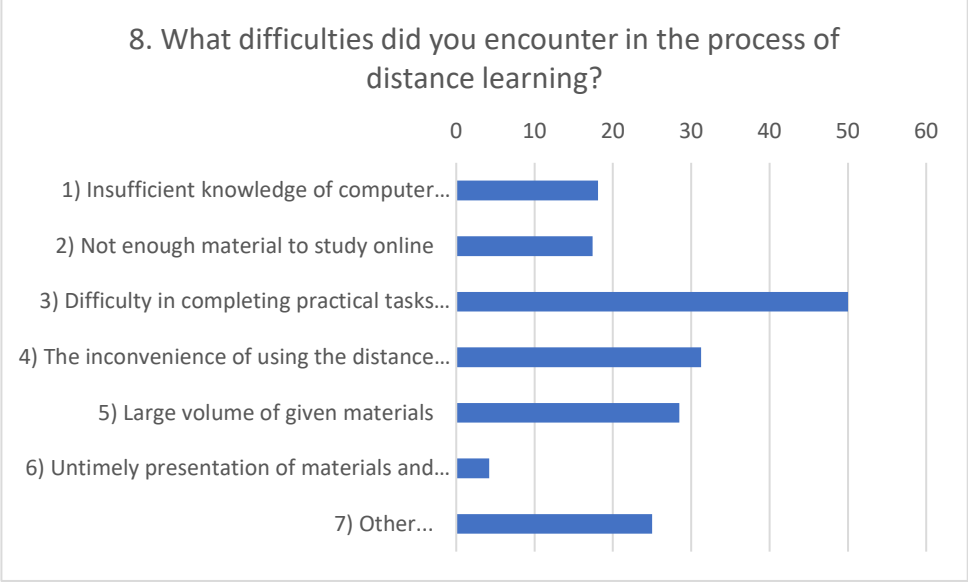

Figure 8 - Difficulties appeared in online learning

The authors of [9] indicated that the problem with a poor Internet connection was named by 48% of students, 24% of respondents declared the inability to work with online courses, 21% - had technical problems, and 59% had insufficient IT skills. In [12], Internet problems (81.7%) were also named as the main problem of online learning, which was accompanied by technical problems (65.5%).

According to our survey (question 2), slow internet connection and technical issues are one of the greatest disadvantages of online learning. More details about this. Slow internet connection was a problem for 53.5% of students. 33% of respondents were not always able to download or view video materials. For 31% of the respondents, even access to the Internet was a problem (they had to travel outside the settlement to gain access to a high-quality Internet connection sometimes). Other technical problems were mentioned by 26% of students. Only 26% of students had no problems with the Internet (Figure 9).

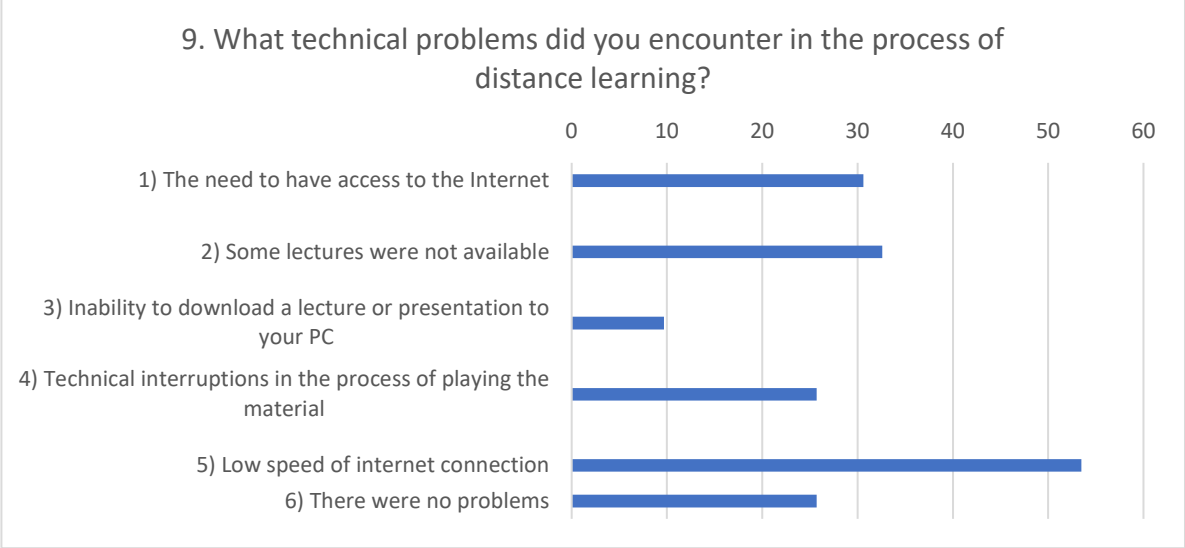

Figure 9 - Technical problems of online learning

Researchers often ask their respondents what form of education they would prefer. According to a study [3], students preferred online lectures to offline lectures, but they would like to keep the online course after the end of the pandemic. According to the results of the work [8], more than half of the participants (80.46%) preferred distance learning through Zoom online lessons, followed by video-recorded classes (19.48%) and theoretical lectures (0.04%).

The authors of [11] believe that, in general, students have a positive attitude towards the use of e-learning, which is underused in medical education. They plan to use it to aid learning in the future. While traditional learning remained the favorite (45,9%), many liked the idea of hybrid education or blended learning (41,2%). However, only 30 (8.8%) participants were in favor of exclusive online learning. According to their results, 77% of students have negative perceptions of e-learning. However, the authors of [6] argue that overall, 58.9% had a favorable attitude regarding e-learning.

According to our research, student votes are distributed as follows: 46.5% of respondents would prefer completely offline learning; 44.4% of students consider blended learning to be the best; 9.1% of students would prefer to study entirely online (figure 10). Our results correlate very well with the results of [11].

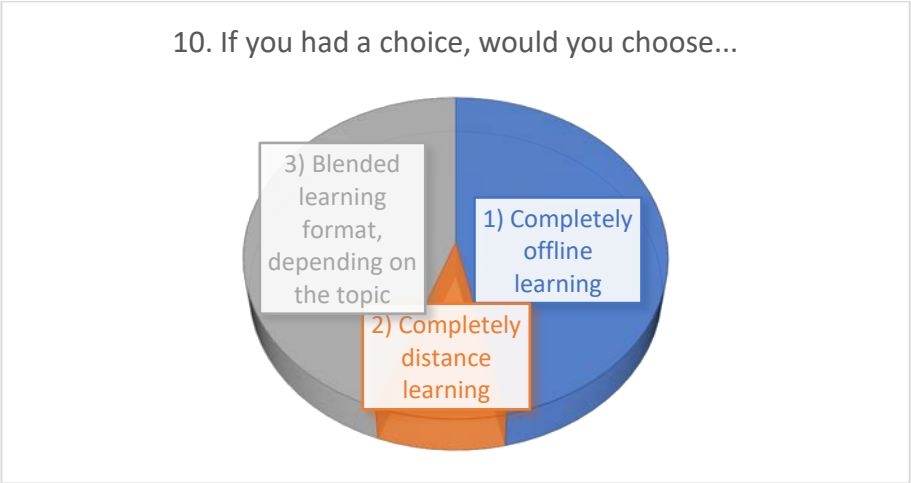

Figure 10 - The choice students would make

Although more than half of the respondents are positive about e-learning, students prefer traditional face-to-face learning more. This may be due to practical issues and the introduction of new learning phenomena. The educational system should use programs to improve e-learning that are more convenient and technically sound. A blended approach to teaching and learning may create new opportunities in the field of medical education soon [12].

Digital technologies provide many new opportunities for both teachers and students, which allows you to automate most of the educational work, save time, quickly find the necessary information, socialize, and improve yourself, freeing up time for individual work with students. Students were generally positive about e-learning and wanted to continue distance learning along with traditional learning, i.e., blended learning. Exploring the merits and barriers to e-learning during a pandemic can guide introducing blended learning into medical curricula to enhance the teaching/learning experience [11].

Conclusion

We concluded that a blended learning format is preferable. It is necessary, if possible, to level the shortcomings of distance learning, and to widely use it for teaching chemistry along with the offline format. It is very convenient to apply e-learning when using the flipped classroom methodology in the classroom. Students use video lectures, presentations, and other preparatory material provided by the teacher in preparation for the lesson. It is quite justified to conduct consultations before class or before the exam also in an online format. With proper preparation, organizing effective communication is quite possible. The videoconferencing mode is practically in no way inferior to a face-to-face meeting, and correspondence and cross-exchange of views on completed tasks even have some advantages over a live dialogue: impulsive statements that could negatively affect the relationship of the parties are minimized, lots of meaningful feedback is provided, and the inclusion of all participants in the interaction process. In addition, individual or group correspondence is possible using an instant message system, forwarding tasks, and receiving comments.

We would like to note that there are pluses and minuses in each of the formats. This was confirmed in a survey conducted among 1st-year students of KazNMU, who studied chemistry both online and face-to-face, and, therefore, had the opportunity to compare these teaching methods. Most students had technical problems with the Internet connection during online learning, another significant problem for them was the lack of communication with group mates and teachers. Offline learning does not have these drawbacks. However, online learning has the advantage of flexibility in time and space, one can study anytime and anywhere, and use the required amount of time for learning. Many students appreciate these benefits. Therefore, we plan to make efforts to develop blended learning in the teaching of chemistry at a medical school.

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МЕДИЦИНАЛЫҚ ЖОҒАРҒЫ ОҚУ ОРНЫНДА ХИМИЯНЫ ОҚЫТУ БАРЫСЫНДА ОНЛАЙН ЖӘНЕ ОФЛАЙН ӘДІСТЕРДІ САЛЫСТЫРМАЛЫ ЗЕРТТЕУ

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Аңдатпа. Жоғары медициналық білім беру бұрын қашықтан немесе онлайн режимінде жүзеге асырылмаған. Пандемия жылдары бұл жағдайды өзгертті. Онлайн сабақтар тіпті медициналық жоғары оқу орындарында да өткізілетін болды. Біздің мақсатымыз студенттердің пікірі және көзқарасы арқылы онлайн және офлайн оқыту әдістерінің артықшылықтары мен кемшіліктерін анықтау болды. Бізде семестрдің бірінші жартысында онлайн, ал семестрдің екінші жартысында офлайн режимінде оқыған студенттердің көзқарасымен химия бойынша онлайн және офлайн оқытуды салыстырудың бірегей мүмкіндігі болды. Бұл студенттер химияны оқу кезінде осы оқу форматтарының оң және теріс жақтарын салыстырды. Медициналық оқу орнында оқитын студенттерге арналып, химия пәнін онлайн және офлайн оқыту ерекшеліктері жайлы ақпарат жинауға және салыстыруға арналған сауалнама дайындалды. Білім беру мен білім алудың әртүрлі әдістерін бір адамдар салыстырғандықтан, субъективтіліктің салыстыруға қосқан үлесі теңестірілді. Қазақстандық студенттердің сауалнама жауаптарының нәтижелері талданып, басқа зерттеулердің нәтижелерімен салыстырылды. Зерттеу авторлары студенттердің пікірлері медициналық жоғары оқу орнында білім алатын студенттердің оқу сапасын жақсартудың қол жетімді және заманауи әдістерін әзірлеуге және пайдалануға көмектеседі деп санайды.

Тірек сөздер: оқыту, аралас оқыту, жоғары білім, медициналық білім, химияны оқыту, онлайн оқыту, офлайн оқыту, білім беру технологиялары

СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ ОНЛАЙН И ОФФЛАЙН МЕТОДОВ ПРЕПОДАВАНИЯ ХИМИИ В МЕДИЦИНСКОМ ВУЗЕ

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Аннотация. Высшее медицинское образование никогда не было дистанционным или реализованным онлайн. Годы пандемии изменили ситуацию. Онлайн-занятия становятся все более распространенными даже в медицинских вузах. Нашей целью было выяснить преимущества и недостатки онлайн и офлайн методов обучения с точки зрения студентов. У нас была уникальная возможность сравнить онлайн- и офлайн-обучение химии глазами студентов, которые первую половину семестра обучались онлайн, а вторую половину семестра офлайн. Эти студенты могли сравнить плюсы и минусы этих форматов обучения при изучении химии. Опрос был разработан для сбора информации и сравнения онлайн-преподавания и оффлайн-преподавания химии для студентов-медиков. Поскольку разные методы преподавания и обучения сравнивались одними и теми же людьми, вклад субъективности в сравнение был нивелирован. Результаты ответов на анкеты студентов из Казахстана были проанализированы и сопоставлены с результатами других исследований, проведенных в других странах. Авторы исследования считают, что отзывы студентов могут

помочь разработать и использовать более доступные и современные метода преподавания и способы повышения качества обучения студентов-медиков.

Ключевые слова: обучение, смешанное обучение, высшее образование, медицинское образование, преподавание химии, онлайн-обучение, офлайн-обучение, образовательные технологии

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